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Abstract. Sustainable transitions are challenging management and leadership in architectural practice. As means to overcome fragmentation and drive for sustainability, co-creation has become an emerging trend in construction management research and architectural practice. The early 'fuzzy' phase of projects has been identified as of great importance to integrate multi-disciplinary perspectives in the design. With action research in architectural practice, three perspectives of co-creation processes were explored to achieve an integrated sustainable design. The experiences are reflected upon, in-action and in retrospect, and through the FfC framework (Framework for Co-designing), the paper contributes with new insight on success/advantage of co-creation processes for sustainable design. Such advantages include the integration of multidisciplinary competences, the creation of stakeholder value and engagement in early phase construction. Further, action research, and especially Gestalt practice and theory, brought a new relational approach to co-creation processes in early design. The architect, in the new role as 'knowledge-process designer', shifts focus towards designing interaction instead of artefacts, and thus contributes to SDG 17-Partnerships. The contribution to practice was twofold; 1) a new digital participatory design tool; 2) an innovative sustainable design solution for urban resilience supporting SDGs 11-Sustianable cities, 3-Health, and 14-Climate.

1. Introduction

The demand for sustainability has brought new challenges to construction projects. E.g. the SDG framework (17 goals and 168 sub-targets) and dealing with so called 'wicked problems', increased complexity and fragmentation of competences, especially in the early 'fuzzy' front-end of projects. It is today common knowledge that design - the early phase of construction, has significant impact on sustainability outcome. This 'fuzzy' front-end of projects is an interesting area for more research [1]. In this critical phase, considerations of many natures come together, e.g. understanding of users, contexts, technology and material solutions, information technologies.

As a result, collaborative approaches are introduced and are changing current architectural practice [2]. Computational/regenerative design, the integration of BIM, GIS, VR/AR and digital twins, are just a few examples of collaborative methods between humans and digital techniques that inform knowledge processes in a new way. Other collaborative processes tend to move towards a user centric development, engaging a larger scope of stakeholders in co-design processes. The last decade has also shown an increase in collaborative research in early phase construction; Action research or Living Lab research-environments with transdisciplinary knowledge processes involving professionals from practice and academia in 'practice-as-research' [2]. This is part of a larger shift towards the co-creation of knowledge as general epistemological stance – a shift from *"mode 1 to mode 2 knowledge production"* [3]. In the Nordic countries, there are many examples of such research projects; e.g. SIRen, HSB Living LAB [4], Grön Bostad, Södertörnsmodellen, NDS, Mistra Urban Futures. Some of these emphasis new process-related roles; the architect as facilitator or as designer-researcher, as important to the development of collective creativity and knowledge production in general in the sector [5].

Co-design; the collective creativity as it is applied in the whole design process, and Participatory design; processes that involve non-professionals, are not new. In design research, the concept was first published in the 1971 conference book *Design Participation (1972)*, in which Cross wrote: *"There is certainly a*

need for new approaches to design if we are to arrest the escalating man-made problems, and citizen participation in decision making could possibly provide a necessary orientation". In Sweden, participatory design processes have developed from the 1970-ies workplaces' participatory planning processes, to healthcare and urban planning [6] [7]. Research on participatory design and co-design have a long tradition in Swedish healthcare projects [8] [9]. The question is not if users should be involved, but how, and there is a great demand for new methods and tools where design professionals engage users in the actual design [8]. Presently, collaborative methods shift from mere collaborating to more joint interaction [5]. 'Symbio city' [6] and 'Design-dialogen' [7] are examples of such participatory knowledge processes reaching international design practice outside of Sweden.

The early stages of projects can be seen as the *"management and organizations of interactions"* [10]. However, there are few studies on early stages that focus on the actual design of interaction in co-creation processes. The current paper takes its departure in such focus on the early phases of three co-creation processes that were designed, facilitated and carried out as action research. All three co-creation processes address the same design-concept - the 'eco-canopy, with the insider perspective of the participant architect-researcher. As co-creation is a group activity; a social-psychological and cognitive process consisting of human interaction within a social system, an action research was found fitting [13]. The aim is to bring light upon how co-creation processes should be designed. Three different approaches for co-creation were used separately in the three projects: 1) design thinking, 2) action research (AR), and 3) the Gestalt approach. The success/advantage of these three approaches are here analyzed in retrospective through the lens of a framework called *Framework for Co-designing* (FfC), which has been developed in healthcare research [8]. The FfC framework, originate from research on co-design in Swedish healthcare, and 'Design-dialogen' have over 100 researched cases of participatory cross-disciplinary co-design processes [7].

2. Introduction to concepts for co-creation and participatory research

In the following paragraph FfC, along with the three different co-design approaches are introduced. Each of the three cases illustrate a co-creation process either common or emerging in architectural practice today. The first, design thinking in multi-disciplinary teams, has become common practice. Second, the boundaries between architectural practice and research are becoming less obvious, and the future will most likely see a larger share of collaborative, transdisciplinary and action related research [2]. Last, a recent trend in management and organization practice includes social and psychological theoretical influences such as the Gestalt-approach.

2.1. The Framework for Co-designing (FfC)

Healthcare design in Sweden has a mature research practice on co-design in multi-disciplinary teams. Characteristic for these are; dialogue, iterations and reflective processes, as well as strategically designed workshops that involve end-users in a facilitated design-process [10]. By using design-artefacts, a group explore organizational activities and spatial relationships. Architects have the role of facilitators and document the output of the workshops, which for example include SWOT analysis and discussion of different alternatives/scenarios. Recent research in healthcare co-design offers a framework – FfC, which supports the evaluation of quality of a co-design process from four angles: *representativity, continuity, ownership and innovation* [8]. 1) A wide *representativity* of stakeholders lends credibility to the output. However, finding the right participants and get them involved in the process can be challenging. Large groups can also slow down the process or it can lose its depth. Breaking up large group discussions into small group-dialogues reduces hierarchal dynamics and neutralizes dominant participants. 2) In terms of *continuity*, the sharing of experiences secures knowledge transfer and greatly influences group maturity over time (trust), and engagement and ownership of results. This is important to consider for leaders, as new people can threaten the confidence for the process. 3) Strong *ownership* reduces risk of losing collectively constructed concepts and gives the participants a sense of involvement and influence over the outcomes. Ownership also influences group expectations about the solutions meeting requirements. Important factors are the group's mission,

pre-conceived ideas upon entering the process, level of commitment, continuity and readiness to discuss issues. 4) Important factors for *innovation* are the combination of engaged individuals, the workshop group, competent architects, and a desire to create something good. Challenges are for example a lack of knowledge of new solutions, or hierarchies that suppresses the sharing of views and perspectives.

2.2. Design thinking

Design thinking is the architect´s or the designer's method to produce knowledge for a possible future. It is a future oriented process of forecasting a desired outcome of what 'might become' [11] [12. Process characteristics are: dialogue, iterations and reflection and mainly include design professionals. The designers explore spatial relationships, sketch and prototype, they use tacit knowledge and 'reflection-in-action' [12], to inform and further alter the design. The design is created in a process of framing and re-framing of the solution space, prototyping, reflection and making alterations. Complexity is dealt with by testing different scenarios or back-casting a desired future. Solutions are commonly identified and supported through images, diagrams, prototypes, 3-Dmodels, reference objects, and simulations/calculations. Processes can be facilitated, self-regulated or more individual.

2.3. Transdisciplinary action research

The grandfather of action research (AR) – Kurt Lewin, a professor at MIT, first coined the term "action research" in 1944. AR is a philosophy and methodology of research generally applied in the social sciences; a simultaneous process of taking action and doing research, which are linked together by critical reflection. AR practitioners reflect upon the consequences of their own questions, beliefs, assumptions, and practices with the goal of understanding, developing, and improving social practices. In order to understand social issues and change social practice, researchers must engage with the relevant practice (social group) in knowledge production that uses the AR cycle: *"a spiral of steps, each of which is composed of a circle of planning, action and fact-finding about the result of the action"* [13]. Process characteristics are: dialogue based, iterative and reflective processes, where academia and practice work together to address issues they want to change. The researcher relates empirics to relevant theory to inform practice in an abductive process. Research ethics is of great concern and must be clearly communicated. The action researcher (architect or other) is responsible for the knowledge process and documentation of the AR-cycle.

2.4. Gestalt theory & practice

Gestalt theories date back to studies on visual perception in the early 20th century. Max Wertheimer, Kurt Koffka, Wolfgang Köhler and Kurt Lewin were founders of the development in social psychology and cognition in terms of 'Gestalt-laws': humans create meaning of the experienced reality by connecting patterns and relationships into a meaningful whole 'Gestalt'. This is called the figure/ground process [14]; a group co-create meaning together by reflecting on the sensory impulses from reality which are filtered through personal experiences and needs, 'the situation' comes into awareness - a 'gestalt'. In a healthy process, the 'Cycle of Experience' (CoE); impulse-awareness-energy-action-closure-rest, creates engagement towards taking action on mental and emotional needs. Gestalt process characteristics are: dialogue based, iterative and reflective processes with a relational perspective on groups as social systems. A Gestalt co-creation process requires an active, voluntary interaction where participants share perspective with each other in a democratic non-hierarchic order. Process values/routines are communicated and accepted by all. The process can be self-organizing or facilitated, yet always participatory. The process has a clear start/end and activates the body and sensory system. In various dialogue-exercises, the participants reflect on the process itself as well as their interaction in real-time. Furthermore, in social systems, there is a mental (energy) forcefield within the group that strives for balance between psychological forces for, and against change. When all forces are expressed and accepted, change can come from within [15]. Coaching techniques are used to map and analyze the relevant social systems (sociogram) and guide the process further. Through the legacy of Kurt Lewin, related theories later became the foundation for group psychology,

organizational development and action research. Recently, gestalt-theories has had influence on interaction-design by providing information on how the human brain interprets different patterns, shapes and colors to organize meaning in screen- and web-design [14].

3. Method and research approach

The paper is based on a retrospective reflection on three differently designed co-creation processes. In all three cases, an architect-researcher participated in multi-disciplinary teams, with the aim to develop project requirements and sustainable design for a design concept called 'eco-canopy' (Figure 1).

The architect-researcher developed an insider perspective [13] to the empirical material, as participant and facilitator in all three projects through the engagement with stakeholders during the act of co-creation, and thus developed in-depth context dependent knowledge [17]. An abductive approach was used, meaning that the process of analyzing the material and consulting previous research and theory was iterative. Data for the retrospective analysis are: documents (planning the workshop and agenda of facilitation); personal reflections (as written notes after each iteration); feedback from participants at the end of the meeting (verbal or through digital inquiry).

In the following, short summaries of the three co-creation processes are presented.

3.1. Case A- Design thinking.

This was a competition entry with a small budget for which a multi-disciplinary design team worked during three months. The task was to come up with an applicable idea for how to reuse low-heat energy in district heating system. The design team consisted of seven professionals from the same architecture firm: The architect-researcher, two landscape architects, a digital design architect, an environmental specialist, an energy engineer, and a visual designer. The architects-researcher and the energy engineer were sharing formal responsibility for the process, however activities and decisions unfolded in a self-organizing manner. The process evolved through typical design-thinking: a free-flowing group-dialogue with spontaneous reflections regarding the solution space, sketching and discussing different design options. The 'eco-canopy' concept was introduced by the architect-researcher as one out of several possible solutions, and the group chose to develop the concept as the competition entry, using 'designerly' tools, e.g. diagrams, illustrations, images, a simple digital 3D model. All participants gathered references supporting or contesting different aspects of the design concept. A basic energy calculation was later executed for the chosen design to convince that the concept met sustainability requirements set out by the team. The design output was sustainable and fully integrated, however, only on conceptual level. The team won the 'Honorary prize' as 'the most innovative and holistic design solution'.

3.2. Case B- Action Research.

This was a 3-year transdisciplinary research project focusing design processes and 'transforming sustainable design' financed through the Nordic Built Foundation. It involved a large group of practicing architects from five companies, and academics (and master students) from four different architecture and engineering faculties in the Nordic countries. The research group met twice a year in 1-day conferences to exchange knowledge and adjust the next cycle of knowledge-building – an AR iteration. Different topics of interests were presented by practice and investigated by academics and master students. Some students chose to research different angles of the 'eco-canopy' concept in a feedback-dialogue with practicing architects, and academic professionals (architects and engineers). Physical meetings with the architect-researcher were set up 4-6 times yearly, with additional skype meetings. The knowledge building of each master thesis was accumulative towards an integrated whole, yet contributed with individual perspectives, and was presented to the architect firm who developed the eco-canopy. The knowledge output was very rich in content. The design output was academically thorough, relevant and also contributed to change the normative sustainable design practice at the architectural firm where the architect-research work.

3.3. Case C- Gestalt co-creation.

Gestalt theories for co-creation in organizations were used in a 1-year R&D project. The architect-researcher designed and facilitated the process, which started with a mapping of social relationships. This guided the process to include necessary participants at an early stage. These were the clients and their facility management, and the local government. Other identified participants were academics, future end-users and a multi-disciplinary design team consisting of: energy engineers, architects, project managers, action researchers, ecologists, environmental specialists, systems-engineers and a parametric design team. Later, over 200 citizens (end-users) were involved in the co-creation process through a new purpose- developed digital participatory design-tool, and an explanatory video with a design related inquiry. In short time, and on low budget, user perspectives regarding the eco-canopy concept's functionality, its materials, and space affordance, were incorporated in the design process in a time-efficient manner. The need to engage more participation, was highlighted during an exercise that explored 'the feeling of resistance'. The process participants were engaged in facilitated workshops, which activated the body and the sensory system. In dialogue in small and large groups they reflected on project requirements/-solutions, as well as on the process itself. The strong process created engagement, and an open trustworthy atmosphere for sharing individual perspectives. After the first workshop, the participants could choose their further level of engagement. The R&D-funding secured participation for the consultants. The participants spent a considerable amount of time, sharing individual experiences, sketching design solutions and visiting a selection of reference projects. In between workshops, individual work was executed and presented at the next workshop. Decision were made by facilitated exercises. The design output came late in the process, however showed a high level of sustainable integration from a broad range of perspectives. It came as a surprise to the participants, how well the design met the requirements. Participants expressed that the process design and facilitation had a positive impact on the overall engagement. The final design-output was attractive and the knowledge output reliable enough to attract other clients to use the resulting design concept in other building projects.

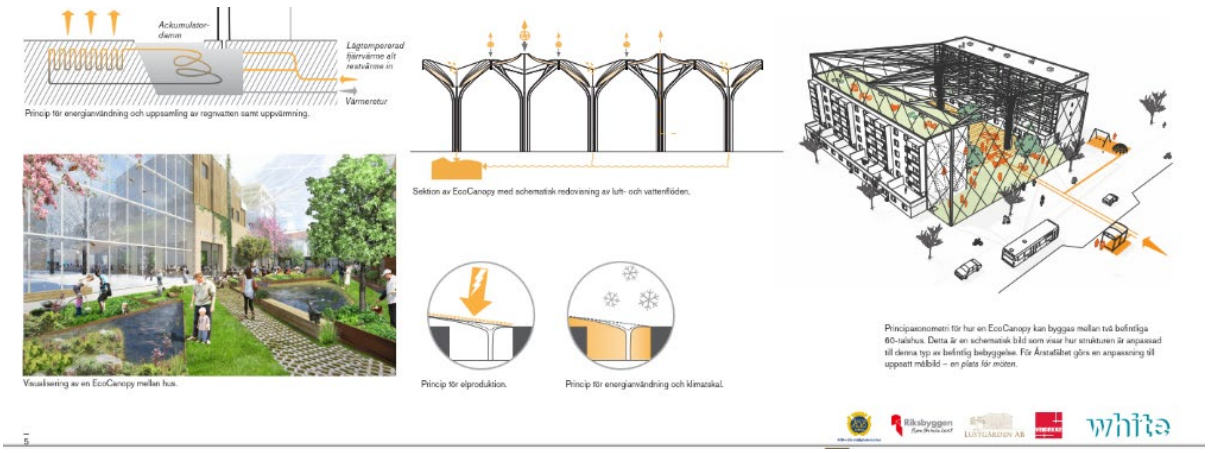

Figure 1. Integrated design based on recycled resources and eco-system services in terms of: architectural form, function, energy, rainwater and social values. The design outputs had relevance to several SDG targets on different scales; apartment - building - neighborhood – city – global scale.

4. Analysis

The study provides a conceptual overview of three different approaches to co-creation processes in architectural practice. Findings show many similarities but also basic differences between the three processes and how they informed the design work, Figure 2. and Table 1 presents a summary of the three cases analyzed through the FfC theoretical framework [8] emphasizing the four concepts: *representativity; continuity; ownership and innovation.*

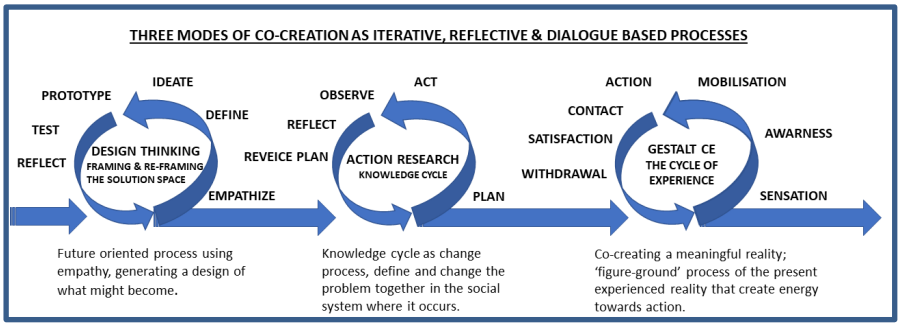

Figure 2. Co-creation processes as iterative, dialogue-based and reflective-in-action.

Table 1. A condensed version of the FfC framework analysis

FfC framework	Case A: Design thinking	Case B: Action research	Case C: Gestalt co-creation
Representativity	Can vary greatly from multi-disciplinary, user-centric co-design, to completely individual processes. Here there was no user or client.	Can vary greatly but always involve both researcher and practice/social system – the group related to the phenomena in focus.	Can vary greatly. The relational perspective - mapping of the social systems and its´ relationships with a sociaogram, supports the search for the right representation.
Continuity	Good. Voluntary and engaged participation, however no guarantee.	Good. Voluntary and engaged participation, however no guarantee.	Very good in Case C; Strong process engaged participants beyond the ones engaged in the project.
Ownership	Strong for the people involved in the process, however lack of client- and user participation and thereby also lack of ownership.	Strong for the people involved and responsible of producing the specific material.	Strong ownership which reached outside of the participant group, mainly due to the digital participatory design tool which involved 200 citizens, as well as created exposure in media.
Innovation	Received honorary prize for most innovative and holistic solution in the competition.	Several results were integrated as new design processes in the company and got funding for a new R&D project for innovative solutions.	A new citizen-participatory design-tool was created and used with excellent results in the project and also integrated as new company service offer. The final design-output attracted other clients to use the innovative concept.
Further info	[18]	[18]	[19] [20]

The FfC highlights some important aspects of the three co-design approaches but not all of their strengths are revealed through this framework. One important finding is that interrelation issues of social and psychological character are lacking in the FfC framework. Furthermore, time limitations, the needed funding, and processes for decision-making which were found to have large impact on the design-output in the studied processes, are not part of the FfC framework either.

In the Gestalt influenced process the relational became a focus instead of the artefact. This is a new perspective to consider when designing and facilitating co-creation processes. The mapping of relationships within the social systems had great impact on the outcomes and for the selection of the right participant for the process, which in turn had impact on the *representativity* of perspectives that could be integrated into the design. If there is no client or user involved, there is no guarantee that the right values are created from a client or a user perspective. The same is true for *ownership* of the results. In general, strategically designed and facilitated processes with dialogue exercises, carried out

in small or large groups, contribute to sharing different perspectives, and was found to be supportive of bridging fragmented knowledge perspectives into a meaningful whole and integrated design.

Time can be most challenging in early phases, and design processes are often rushed towards creating plans for an artefact. Spending precious time on dialogue and on stakeholders' emerging understanding of what they want in the project can reduce time later in the process. Having set the right project requirement and emphasis on value creation is essential when stakeholders need to agree on a feasible and acceptable design-option. Co-creation processes need to strategically support the expression of different perspectives, values and functionalities as it will affect the sense of *ownership* which in turn creates engagement. Designed and facilitated meetings bring more structure to the knowledge production, keeping it relevant to stakeholders, and at best, within the time-limitation of the what is possible in contemporary building industry. Without facilitation, some individuals can dominate the discussion either through their role or their character, and thereby influence the output (e.g integration of sustainability). The facilitator has great influence, responsibility and power, to impact the process and its design output. Gestalt theory brought in a systemic perspective on psychological forces within a social system/group, e.g. the 'resistance to change'.

Finally, the co-creation processes challenge the role of the architect as the main designer, but in parallel offer a new role as designer of knowledge processes.

5. Discussion and conclusion

The paper provides a summary of empirical results and analysis with new insight on how to design co-creation methods to support knowledge work for sustainability in early design phases. The study focus is on the design of interactions in co-creation in multi-disciplinary teams. Success/advantage of quality in co-design was analyzed through the lens of FfC framework. There were both similarities and differences between the three different approaches to co-creation; design-thinking, action research (AR), and the Gestalt approach. Supportive factors in all processes were iteration, dialogue based and reflective processes with an orientation towards change or what something 'might become' (Figure 2). Furthermore, when participants take turn expressing their own views in dialogue exercises supported by designerly-tools, this can help to bridge fragmentation of multi-disciplinary teams.

The FfC analysis highlighted four angles to evaluate co-design processes which illustrated their weaknesses and strengths. One factor was that participants who are active in co-creation sense a stronger *ownership* of the results, which in turn create engagement. Another factor was stakeholder *representation*. The Gestalt focus on relationships, reflecting over necessary relationships and mapping them with a sociogram, was a success factor in terms of *representativity;* how to find the right stakeholders and involve these in the process.

However, seven shortcomings were found to the FfC framework: 1. Lack of focus on relationships, 2. No considerations for time limitations, 3. The need for funding, 4. The necessity to have a decision-making strategy, 5. The need for supporting technical resources, 6. The role of the architect as facilitator, and 7. The abductive approach with theoretical input and especially social psychological aspects that affect the groups' cognitive and collaborative functions. The latter was illustrated in the Gestalt approach that highlighted the social psychological forces within the group. Different interests can lead to power struggles, fragmentation and if managed poorly, end up in a destructive process of negotiations. Instead, when managed with curiosity and a coaching attitude to explore feelings, e.g. 'resistance to change' can be turned into a creative source for new ideas, and increase sustainable value for project stakeholders, instead of becoming 'a force of resistance' that create conflict. In general, all co-creation processes except the Gestalt approach were lacking the inter-relational perspective.

In the studied processes, the 'architect-researcher´' shifted focus from designing artefacts to designing social interaction in knowledge processes. This new role for architects should be further explored. The architect, supported by computers, is trained to handle complexity and so called 'wicked problems. It would be especially interesting, if such 'skills' were combined with social-psychological and cognitive aspects [5] [14] and using computational powers to design interaction in complex knowledge processes. Furthermore, if architects engaged more as 'designer-researchers' [5], and

systematically integrated theoretical concepts into the process, one hand this would be challenging in terms of complexity and time, but on the other hand it could lead to new directions and establish credibility for new solutions.

The paper has limitations. Empirics are based on three case studies with a retrospective analysis from an insider perspective; the involved the architect-researcher. Still the paper offers new perspectives on co-creation processes of multi-disciplinary teams in the early 'fuzzy' phase of design, notably through the introduction of Gestalt theory and the discussion of a new role for architects as facilitators in co-design processes. From the context of knowledge production [4] architects who design co-creation processes with more consideration to social interaction and social psychological factors that affect group-performance, can have implication on knowledge production beyond a sustainable built environment. By engaging in transdisciplinary research, and thus changing the way we do things, architects allow for different ideas and solutions to emerge.

The three studied co-design projects also offer several contributions to practice: 1) the invention of a new digital tool supporting participatory design processes, and; 2) an innovative design solution for urban resilience which support SDGs 11-Sustainable cities, 3-Health, and 14-Climate, see Figure 1. Finally, the academic contribution of this study of co-creation processes is further and mostly related to the SDG 17 - Partnerships for the goals.

References

[1] Edkins A E, Geradi J, Morris P, Smith A 2013 Exploring fron-end of project management, *Engineering Project Organizational Journal,* 3(2), 71-85
[2] Nilsson F, Hensel M U 2016 *The changing shape of practice*, Routledge; 1 edition
[3] Gibbons et al. 1994 The new production of knowledge-the dynamics of science and research in contemporary societies, *London: Sage publications*.
[4] Femenías and Thuvander 2018 Transdisciplinary Research in the Built Environment: A Question of Time. *Technology Innovation Management Review*. Vol. 8 No 8.
[5] Sanders E, Stappers PJ 2008 Co-creation and the new landscapes of design, *CoDesign* 4:1, 5-18
[6] Ranhagen U, Groth K 2012 The symbiocity approach, a conceptual framework for sustainable urban development, SKL international
[7] Fröst P, Gustafsson A, Eriksson J and Lindahl G 2017 *Designdrivna dialoger för arkitektur och samhällsbyggnad*, SWECO FFNS and Centrum för gårdens arkitektur
[8] Ericsson, Fröst and Ryd 2012 Mapping a framework for co-design in healthcare projects, Proceedings from ARCH12
[9] Elf, Fröst, Lindahl, Wijk 2015 BMC *Health Services Research*, 15:114
[10] Söderlund J 2011 Pluralism in project management: navigating crossroads of specialization and fragmentation, *International journal of management review*, 13:163
[11] Dorst K 2011 The core of Design thinking and its application, *Design Studies*, 32(6), 521-32.
[12] Schön D 2017 *The reflective practitioner: How professionals think in action.* Routledge.
[13] Coghlan D, and Brannick T 2014 *Doing action research in your own organization*, SAGE, 4thed.
[14] Mann D 2010 *Gestalt therapy: 100 key points and techniques*. Routledge.
[15] Beisser A 1970 The Paradoxical Theory of Change, In: Fagan, J. and Shepherd, I.L., Eds.,
[16] Graham L 2008 Gestalt theory in interactive media design. *Journal of Humanities & Social Sciences*, 2(1).
[17] Flyvbjerg B 2006 Five misunderstandings about case-study research, *Qualitative inquiry*
[18] Bjerregard, Jenseen, Grosse et al. 2018 *Informing Sustainable Architectures*, DTU. Denmark. Can be downloaded at http://arqforsk.se/
[19] Grosse E 2018 A Gestalt Perspective on Co-Creation, In Proceedings from Arcom conference 3-5 September 2018 in Belfast. www.arcom.ac.uk/-docs/archive/2018-Indexed-Papers.pdf
[20] White arkitekter 2018 Linköpingsborna deltar i utvecklingen av Eco Canopy i Ebbepark, https://whitearkitekter.com/se/news/linkopingsborna-deltar-i-utvecklingen-eco-canopy-i-ebbepark/